MAICH_BioControl Strategies

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Biological Control Strategies

The ladybird *Rodolia cardinalis*, together with its prey, the cottony cushion scale
Foto: Henri Herrera

Biological Control Strategies

Biological control strategies

There are five different types of biological control strategies:

1. *Introduction (classical biological control)*
2. *Augmentation*
3. *Inoculation*
4. *Inundation*
5. *ConservationThe diversity and stability of insect pests and their predators will be influenced by:*

Bio-control Strategies

- Classical Biological Control

- Augmentation
  - Inundation
  - Inoculation

- Conservation Biological Control

Classical Biological Control

1. Definition
2. Used against
3. introductions aim at

Classical Biological Control Definition

The intentional introduction of an exotic biological control agent for permanent establishment and long-term pest control

(Eisenberg et al. 2001)

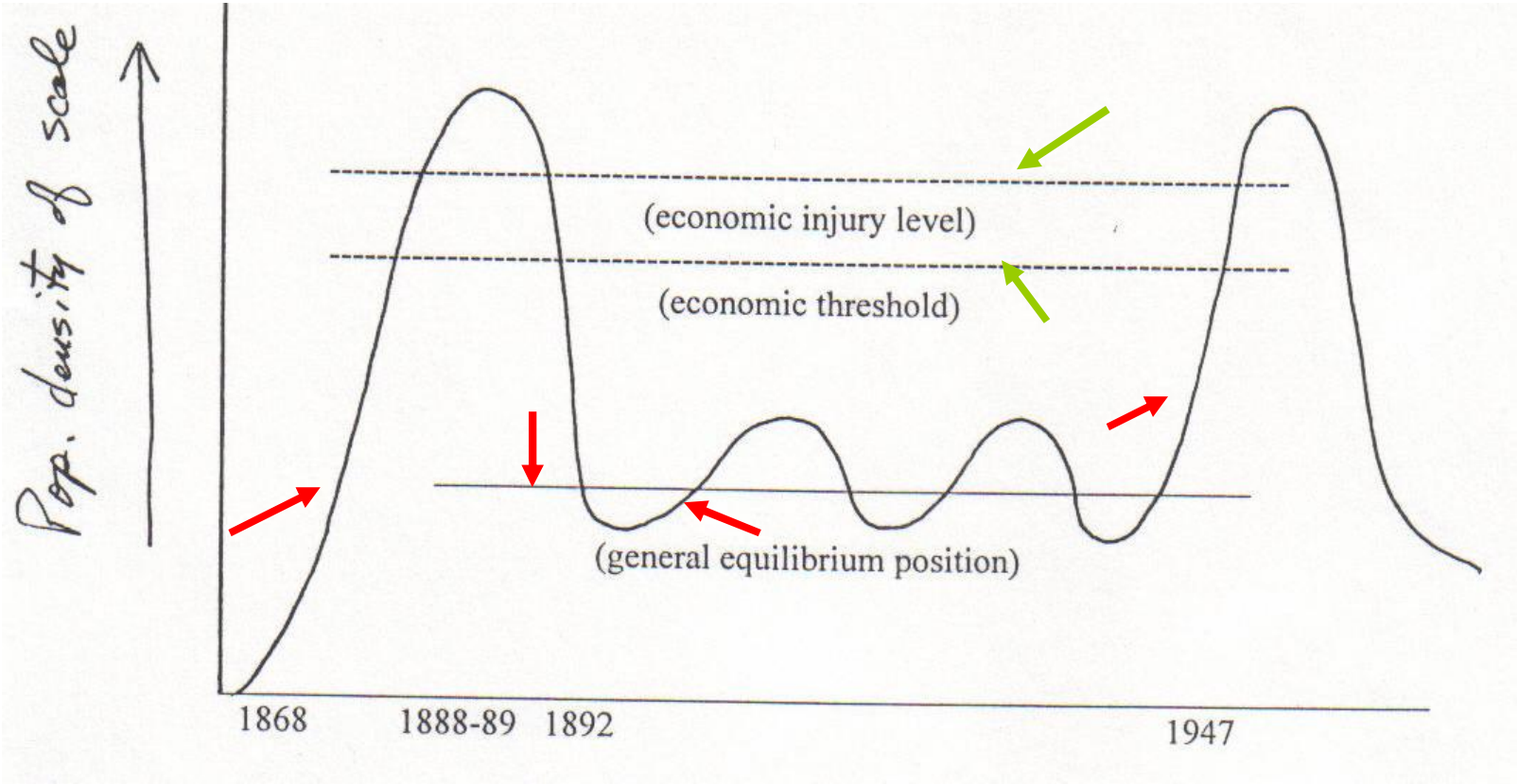
Introduction (classical biological control)

The enemy release hypothesis

- Biological control through introduction is most frequently used against introduced pests, which arrive in a new area (where they become permanently established) without an associated natural enemy complex.
- introductions aim at reaching a fixed presence of a specific enemy in the environment.
- For this reason, it cannot limit itself to the introduction of the natural enemy species,
- but must also foresee all of the strategies aimed at encouraging its survival and diffusion.

- The most famous examples of this technique's application are, besides the already cited *Rodolia cardinalis*,
- the control of *Eriosoma lanigerum* through the introduction of its specific parasitoid *Aphelinus mali*,
- and the control of *Quadraspidiotus perniciosus* through the introduction of *Prospaltella perniciosi.*

History of Control of the Cottony Cushion Scale in California



Graph illustrates effect of pesticides and predators on scale populations

- When a natural enemy is introduced in classical biological control it should, if it establishes itself, reduce the abundance of the pest to a level below the pre-introduction population size.
- After an initial phase, in which there is a rapid reduction of the harmful insect (and just as rapid growth of natural enemy populations), generally follows a long period of equilibrium between the two populations.

- With a successful introduction, this new population level will be well below the economic damage threshold.
- Where successful, this classical use of biological control offers permanent levels of control, with only few risks associated with it and, above all, it provides a very cost-effective solution.

- Classical biological control has been most successful with

pests of fruit,

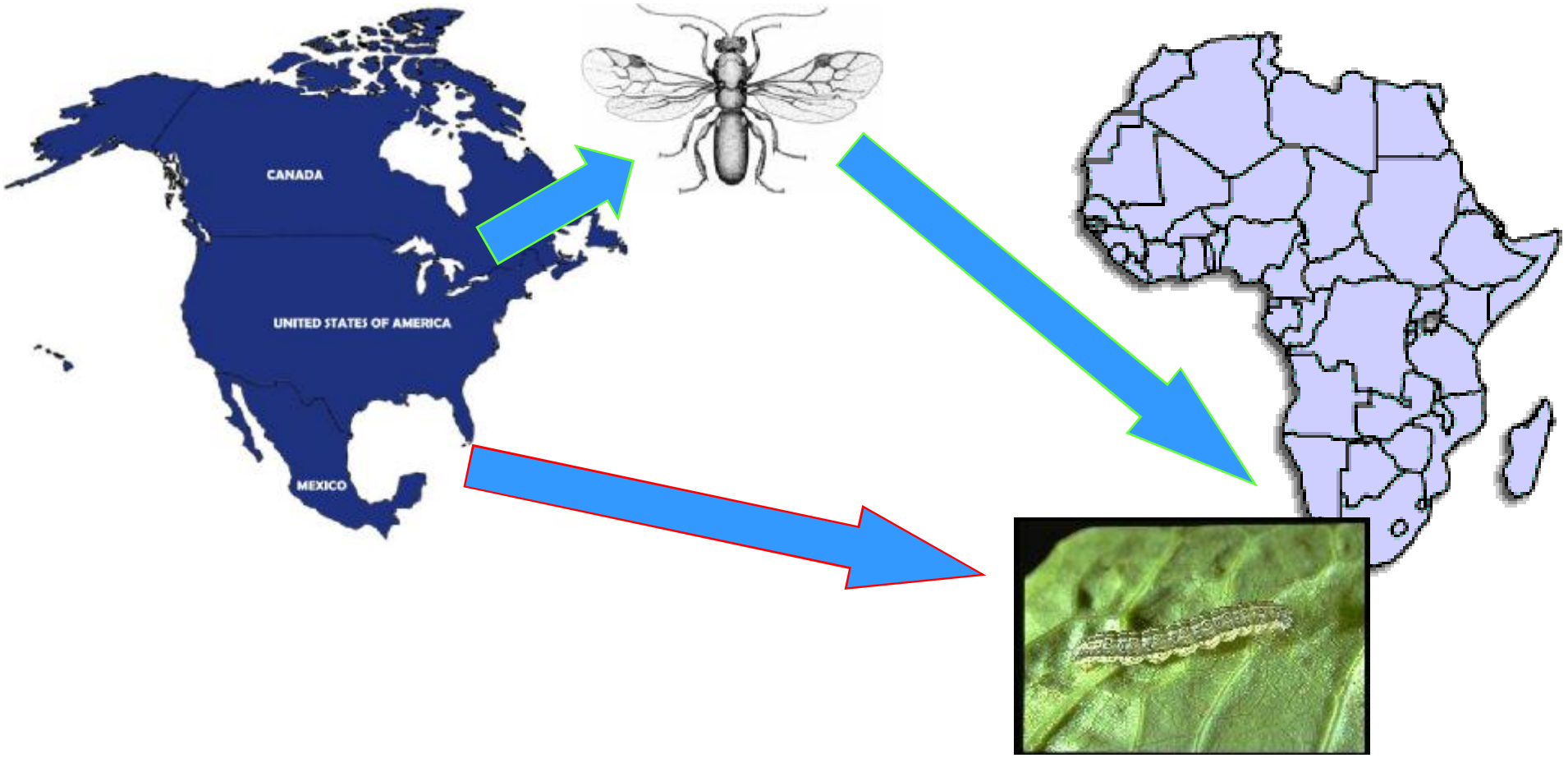
forest and range crops,

- where the perennial nature of the crop permits a continuous interaction between the natural enemy and the pest host,
- without the ecological upheavals that are associated with the management of annual crops.

The enemy release hypothesis

- states that an exotic pest in a new area will increase to pest numbers due to the lack of natural enemies in the new area.
- In their native places the insects that are pests in the new area are not pests because they are controlled by a suit of natural enemies that have coevolved with them in their places of origin throughout their evolutionary history keeping their population numbers under control.

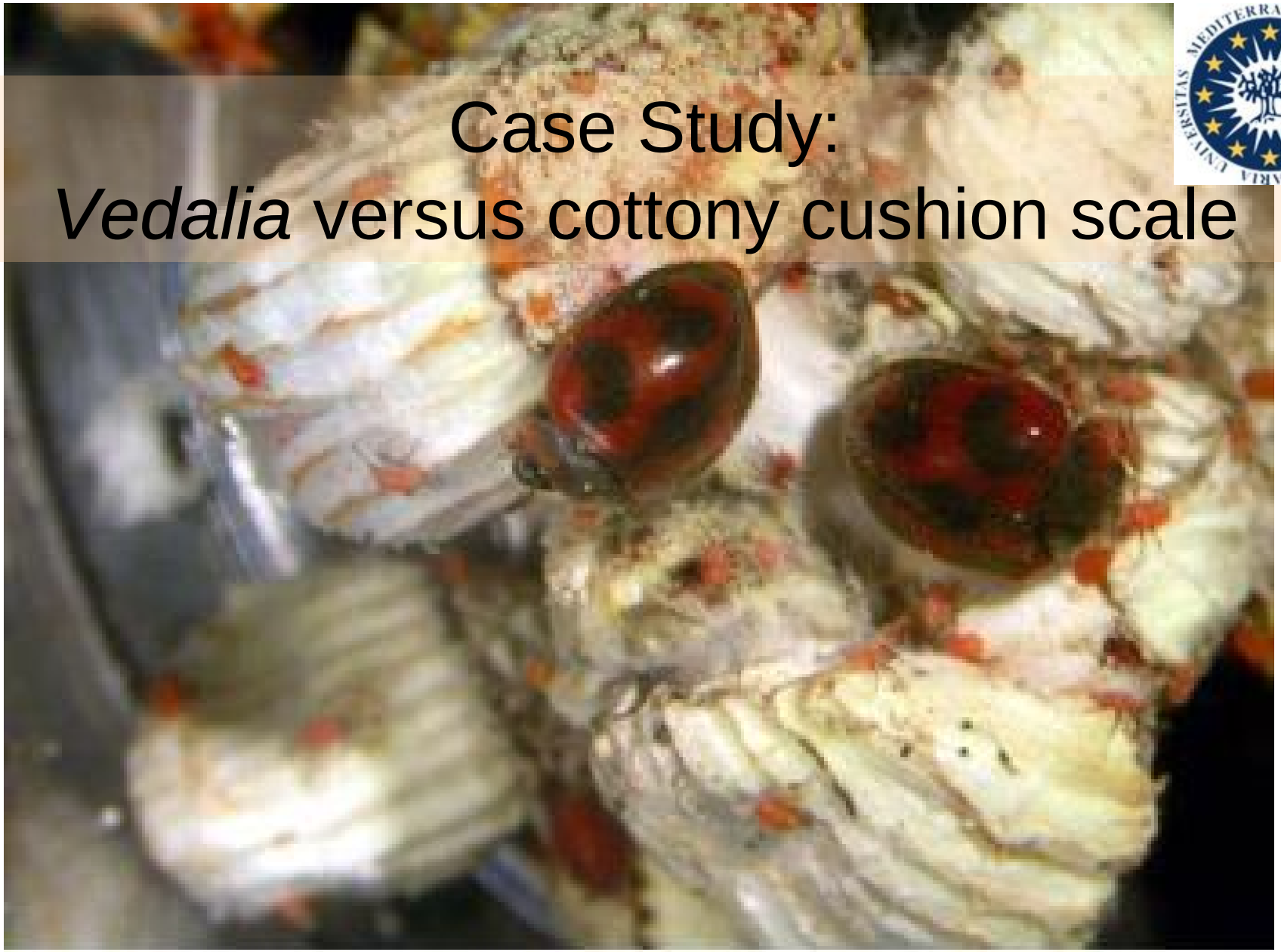
The enemy release hypothesis



Introducing a Natural Enemy

- Identify center of origin
- Foreign exploration
- Quarantine and mass production
- Release and establishment
- Post-establishment evaluation

Case Study:
Vedalia versus cottony cushion scale



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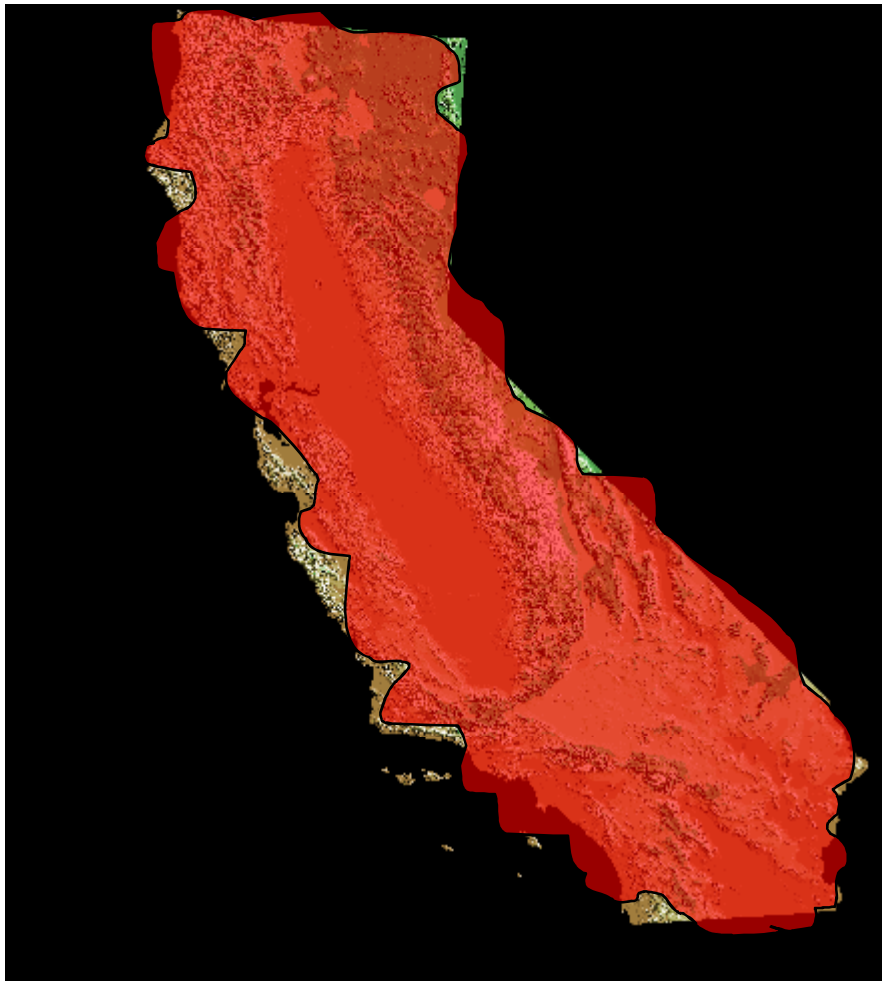
The Cotton Cushion Scale

California 1880

California 1868



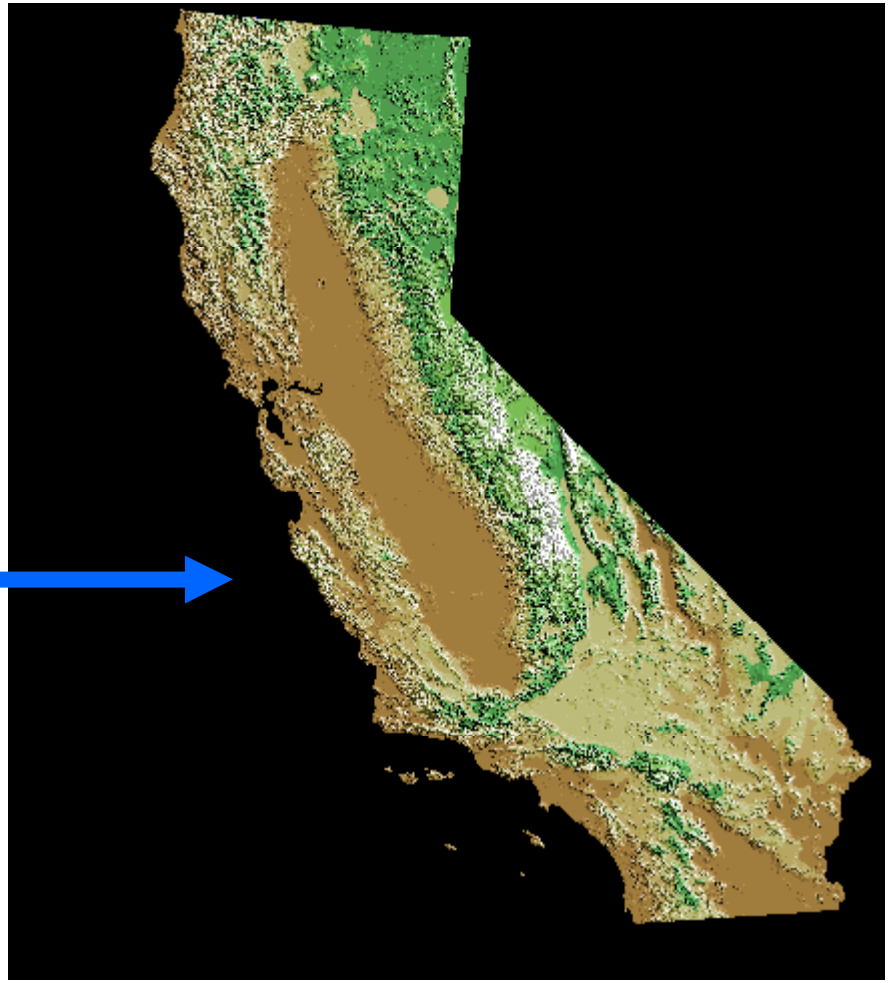
Foreign Exploration

Albert Koebele Traveled
to Australia in 1888

Natural Enemies Found and Shipped!

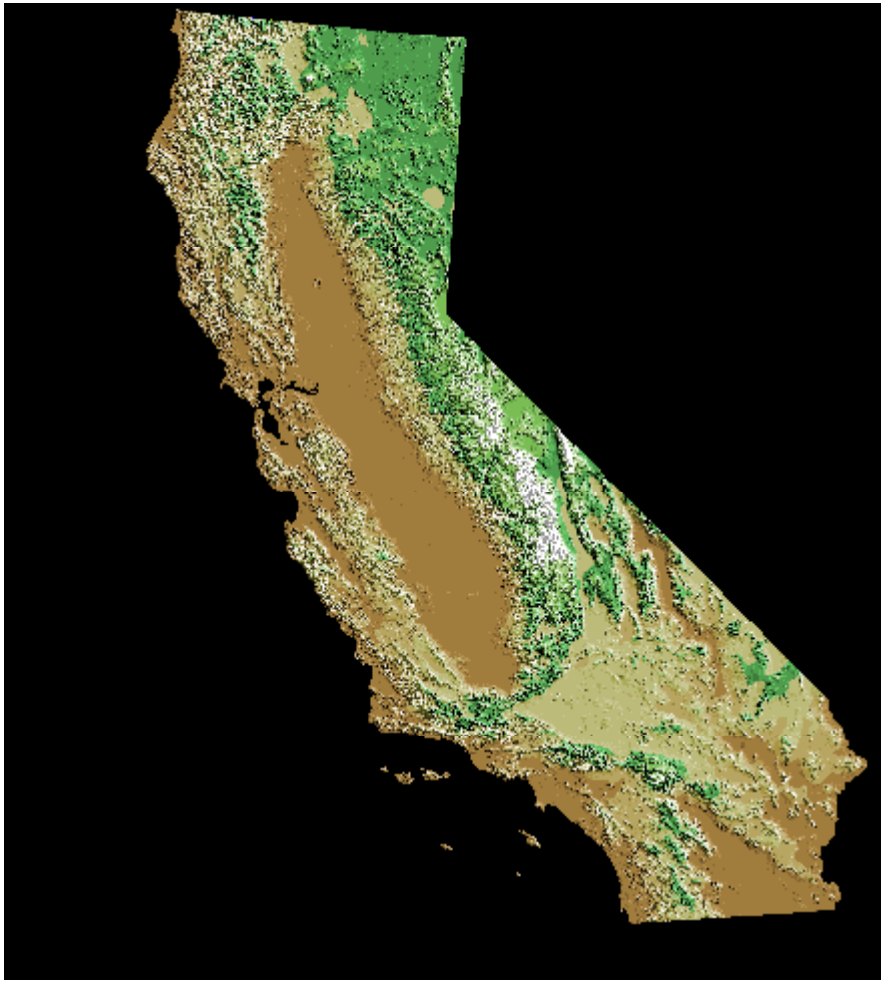
Rodolia cardinalis

Natural Enemy Released

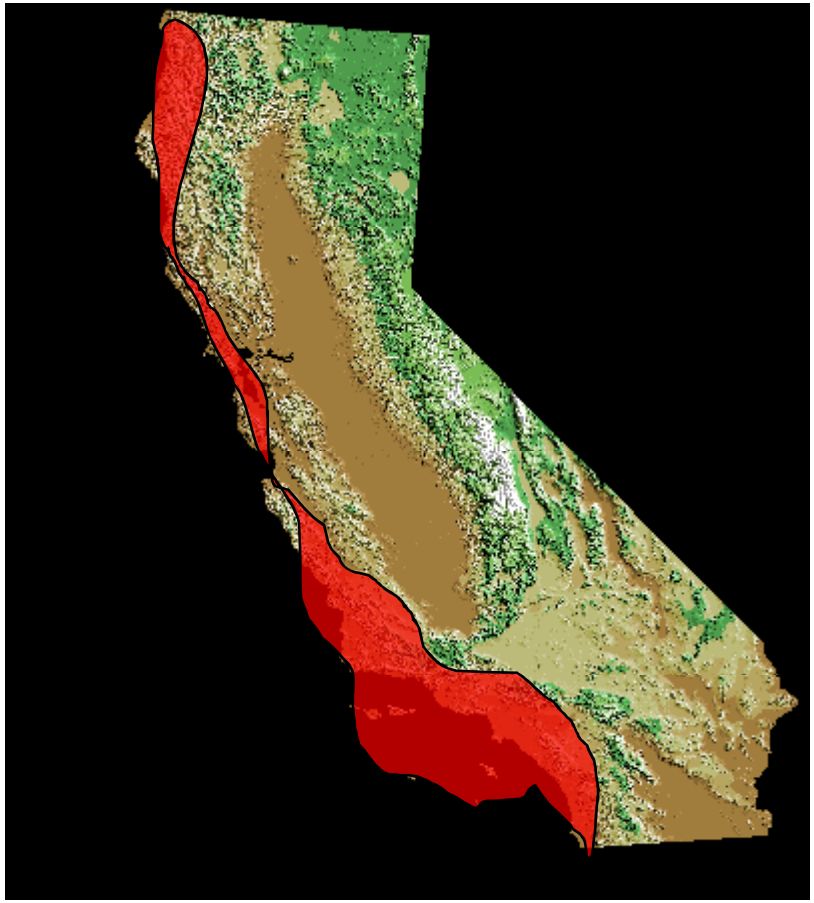


Problem Solved!

1890: Cotton Cushion scale no more



Other Imported Natural Enemy of the Cotton Cushion Scale



The ladybird *Rodolia cardinalis*, together with its prey, the cottony cushion scale
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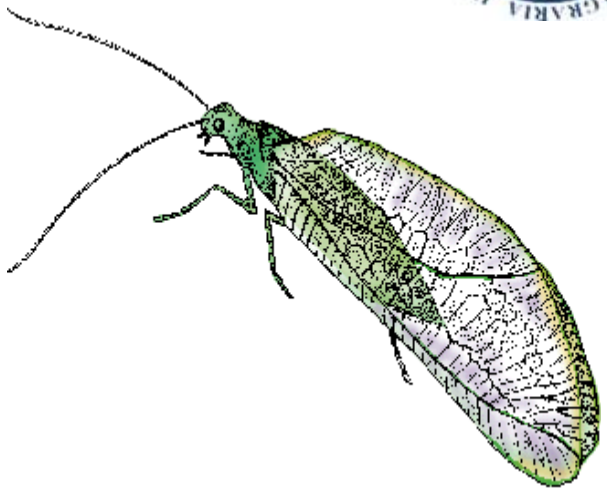
Californians Were Thankful

To Improve Classical Bio-Control Success:



- Climate matching
- Stable habitats
- Simple food webs
- Pest and natural enemy are specialists
- Pest feed unconcealed
- Pests are gregarious
- Numerous releases (different species)

Bio-control Strategies

- Classical Biological Control

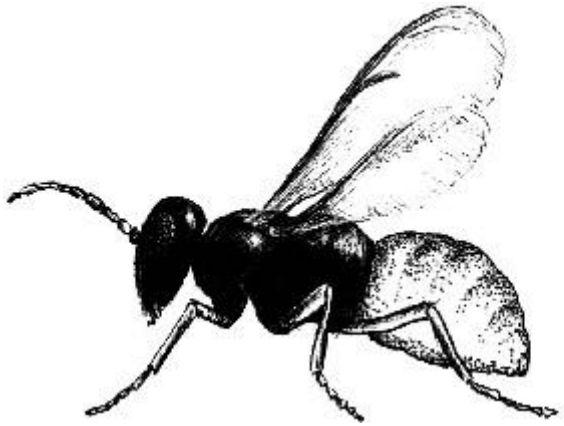
- **Augmentation**
  - Inundation
  - Inoculation

- Conservation Biological Control

Augmentative control.

Augmentation Definition

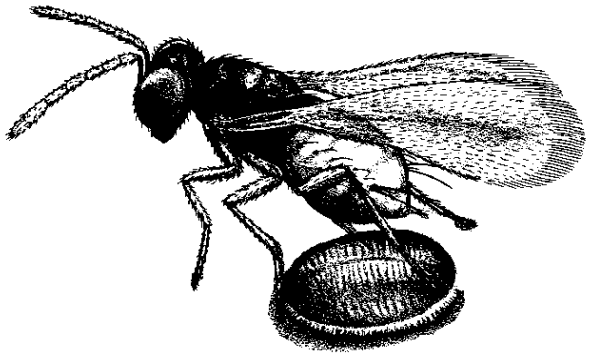
It is the periodical introduction of natural enemies to achieve pest control. Natural enemies used in augmentation do not establish and need to be introduced each time pest populations reach the threshold level.



When to use Augmentation?

- When natural enemies are absent or occur at low numbers

- When natural enemies appear late



Augmentative control.

- This strategy tends to be used in situations where natural enemies are absent or population levels are too low to be effective, so numbers are augmented by the use of laboratory-cultured natural enemies.
- The augmentation method relies upon continual human management and, unlike the importation or conservation approaches, does not provide a permanent solution.

Augmentation

Augmentation

Characteristics

Augmentation

- Release of reared natural enemies
- Temporary control
- Natural enemy should be adapted to focus area
- Easy to culture
- Preference for pest species
- Higher reproductive rate than pest
- Good response to pest density
- Nat.enem. Should not attack others Nat. enem.

Bio-control Strategies

- Classical Biological Control

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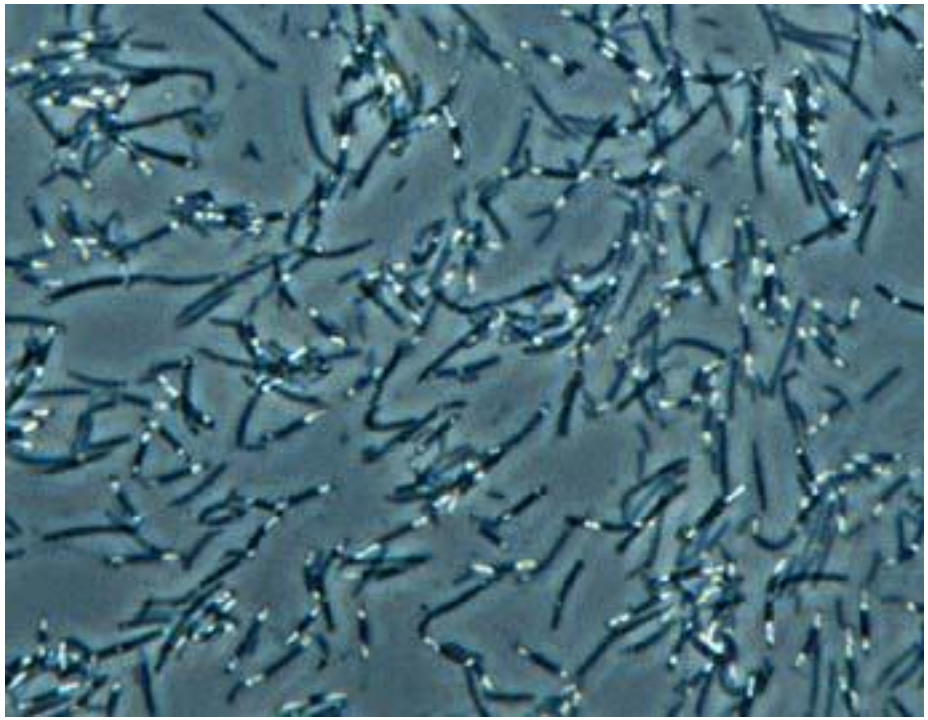
Inundation

Inundation.

- The natural enemy is usually a pathogen and is often formulated so that it can be applied using conventional pesticide spray equipment.
- Sometimes used as substitutes for chemical pesticides, inundative control agents are applied for short-term control when pest populations reach damaging levels.

Inundative Biological Control



- Control agents do not reproduce
- For rapid biological control
- For low economic thresholds


MOSQUITO BITS
Quick-Kill Mosquitoes
Kills Mosquito Larvae Within 24 Hours
Before They're Old Enough To Bite!
Biological Mosquito Control
Sprinkle in any container/pond standing water including water gardens.
CAUTION

Inoculations

Inoculations.

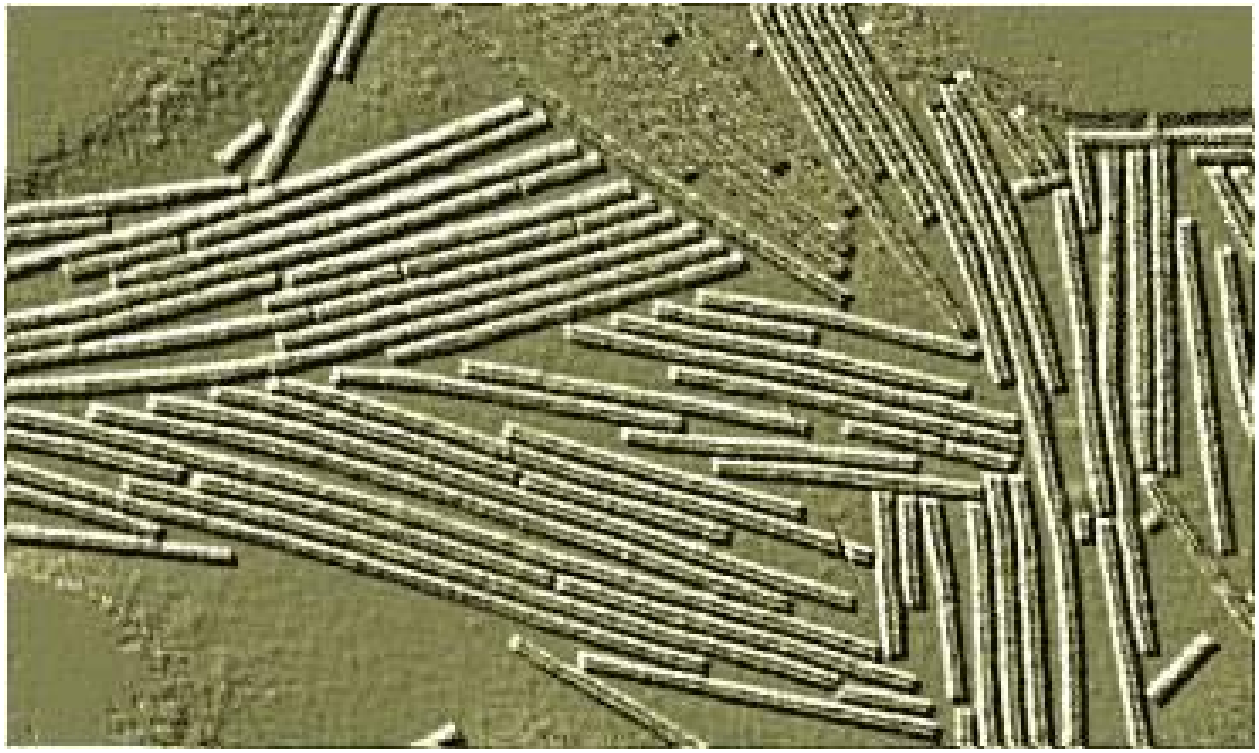
- These are used where a native natural enemy is absent from a particular area, or an introduced species is unable to survive permanently.
- The inoculative releases are made at the beginning of the season to achieve seasonal control, i.e. to colonize the area for the duration of the season (or the crop) and so prevent pest build-up.

- This technique provides longer term control and a relatively more self sustained control than inundation.
- The natural enemies involved in inoculative bio-control reproduce after they are released so innoculative control is characterized by fewer releases than inundative control.
- However, unlike classical biocontrol the released natural enemies do not establish and they die after the growing season. Because they die passed the growing season they need to be reintroduced if the pest problem appears again.

Inoculation

- Control agents reproduce
- Agent persist longer than in inundative control

Why do you think pathogens are more common than parasitoids in augmentative control?



Seasonal Inoculative Releases

- Greenhouses

- For natural enemies that do not tolerate cold weather